Detail Extrapolation via Noise Analysis During Image Capture Process

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Introduction

Opto-electronic sensor noise is something which camera manufacturers have endeavored to, to the greatest extent possible, eliminate. Insofar as this noise cannot be eliminated, unseen patterns in sensor noise may provide clues as to the relative lightness or darkness of spaces between pixels to support meta-pixel construction. Meta-pixel construction may already be achieved through techniques such as sensor micro-actuation when coupled with multiple exposures (something I've referred to as Resolution as a Function of Exposure Time (RFET.) The first iteration of that technique dates back to April 2009 and has since been improved upon with the addition of such concepts as dual-measurement of waves via transparent sensors which incorporate a sandwiched frequency multiplexing prism between a transparent forward sensor and a more traditional, opaque CMOS.

Abstract

Even without using such techniques, existing CMOS sensors can produce enhanced images through a technique rooted in Resolution as a Function of Computing Time (RFCT.)

In RFCT, sensor noise, rather than being analyzed only with filtering in mind, is closely analyzed for discrepancies which do not conform to statistically average behavior for a particular region of the sensor.

In the midst of a digital image exposure, as image construction progresses, noise may be continually monitored and, given sufficient computing power, repeated sample images may be captured of the incomplete image and analyzed in order to identify areas of transiently increased or decreased noise.

It may be predicted that if, for example, there is a dark area more granular in area than a single pixel, this darkness would have a demonstrable effect on the received light from the surrounding area (for example, the black lettering on the side of a tank or an aircraft.) This effect would take the form of inducing an ultra-short gaps in the received lighter-colored light, similar to Alfvén Waves but somewhat less rapid in oscillation and caused by a different effect.

By the same token, if there is a bright spot between the per se pixels, it could be predicted to cause amplitude spikes at a similarly high rate of oscillation.

Although these oscillations cannot be directly captured by extant CMOS sensors, a careful meta-analysis of the sensor noise; an ingredient ordinarily discarded; can intimate the presence of these oscillations. Alfvén-like gaps created by this effect induce current flow from surrounding areas, inward, toward hyper-localized areas of the sensor, leading, ultimately, to increased

noise in the area immediately around the dark spot which result from electrons crossing through the hyper-local area and back into their area of origin. Imagine a circle with a spot at the center wherein the circle shrinks until it converges at the point and then expands outward once again. This effect is not unlike what happens when someone standing in an inner-tube in an above-ground pool pushes down on the inner-tube, displacing water. The displacement of water results in water rushing inward from surrounding areas but ultimately results in waves moving outward, striking the circumference of the pool and perhaps even causing water to splash over the rim and out of the pool.

In the case of the opto-electronic sensor node, the gaps in received waves caused by the above-described effect results in a deficit of electrons and the influx of electrons from surrounding areas. This eventually leads to an overcharge of the sensor nodes, particular in a 'halo' area around the area detecting the gap-filled light. By computing the center of gravity of those haloes of noise to sufficient accuracy so as to be able to determine between which two pixels the source lies, proper spatial addressing can be assigned to the 'dark' spot. By the same token, zones of transiently *decreased* noise could be expected to result from bright spots in the inter-pixel area, although this effect may be less pronounced.

The more 'snapshots' of the choatic noise condition throughout the image capture process (made possible by increasing computing power,) the more information can be deduced about the contents of the spaces between the pixels without the need to take additional exposures or to adjust the sensor or lens orientation.

In this scheme, noise analysis would serve both the purpose of reducing noise in the final product and helping to create a meta-pixel map derived from noise analysis which could, at minimum, double the net resolution of the ultimate image when primary and meta pixels are appropriately integrated.

Conclusion

Through noise analysis on the order of hundreds of thousands of sub-samples in a single exposure, additional details can be extrapolated by converting meta-information about noise patterns into estimates of brightness assigned to specific spatial points within inter-pixel zones.

This technique would provide only monochromatic estimates of brightness values in those inter-pixel zones; a technical limitation. However, as true color values would be known for the surrounding areas and as monochromatic information is typically sufficiently for military intelligence applications (sc. reading the letters and numbers on the sides of aircraft, vehicles and buildings,) this approach would provide tangible benefits to the effective resolution of extant imaging systems through upgrade only of the image processor without the need to upgrade the sensors, themselves.